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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Method and device for recording multi-session information on a multi layer information carrier

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Method and device for recording multi-session information on a multi layer information carrier

The invention relates to a method and a device for recording multi-session information on a multi layer information carrier. In particular, the invention relates to a method and a device for recording information on a dual layer DVD+R or DVD+R/W disc, such that it becomes compliant with the dual layer DVD-ROM standard.

DVD-ROM is successful in both the Personal Computer (PC) world and the Consumer Electronics (CE) world. For film and content distribution dual layer DVD-ROM is frequently used. Recently, recordable (R) and rewitable (R/W) single layer DVD formats were introduced. However, their storage capacity is currently limited to 4.7 GB. More storage capacity is needed for both CE and PC applications. Dual layer DVD+R offers such a capacity increase. It is a dual-layer write-once disc with 8.5 GB of storage capacity. The dual layer DVD+R format should preferably be compatible with the DVD-ROM dual layer format as well as with the single layer DVD+R format. This is important for compatibility with existing DVD-ROM players and PC drives.

Information is stored on these optical record carriers according to specific rules and layouts, generally referred to as formats, which are described in documents generally referred to as a standards.

For dual layer DVD-ROM there are two track modes defined in the DVD-ROM standard (Standard ECMA –267, 120 mm DVD – Read-only disc); Opposite Track Path, OTP, and Parallel Track Path, PTP. For dual layer DVD discs the OTP track mode (as schematically shown in figure 1) is preferred because of a reduced layer-jump time during play-back.

It should be notes that the dual layer DVD-ROM standard requires dummy data to be present after the lead-out zone up to the end of the disc. When this data is not present, the drive may crash. Hence a long finalization time (for recording the dummy data) and a large loss of storage space have to be accepted for DVD-ROM compatibility.
A multi-session layout on multi layer discs is not standardized yet.

It is an object of the present invention to provide a method and device for recording a multi-session layout that exploits the multi layer structure of multi layer discs as well as offers compatibility with existing DVD standards. Preferably, such a method and device keep the finalization time a minimum.

According to the invention, a physical definition of a multi-session format for multi layer discs is presented. The present invention offers a possibility for efficient multi-session layout while maintaining compatibility with existing DVD standards (that is, eliminate open spaces). Furthermore, the basic concept of a super session is presented.

For compatibility with DVD-ROM no empty zones are allowed on the L0 layer and the L1 layer of recordable multi-session multi layer DVD discs between the first PSN on the data zone of the L0 layer, the middle zones, and the disc end at the L1 layer (the L0 layer is the information layer located closest to the side of a disc where a radiation beam, such as a laser beam, used for reading and/or recording the information enters the disc). In figure 1 there is only a small amount of data on the L1 layer. Therefore, there should be dummy data between the lead-out zone and the end of the disc. In a worst-case situation (fully recorded L0 layer and only a small amount of data on the L1 layer) this would mean that almost a full layer of dummy data has to be written. This is time consuming (30 minutes of recording time at a recording speed of 2.4x), and a lot of storage space is wasted. Furthermore, during layer jumps there should always be data on the other layer to guarantee DVD-ROM compatibility.

According to the present invention a super session is defined which includes one or more layer jumps. The method according to the invention comprises at least one such super session.

According to embodiments of the invention the physical address space on a disc is fixed, the position of the middle zone is placed at the maximum PSN number on the L0 layer (this should be written in the lead-in and lead-out zones, as well as in the ADIP information);

empty spaces in a single super session should be as small as possible (this implies a symmetrical distribution of data and files on both layers);

the latest session info (file system info) is included when closing the session (this should be done in such a way that it is compatible with existing DVD standards);

a jump zone of a fixed amount of ECC addresses containing all zero data is written to avoid errors during read out;

intro, closure and jump zones sectors have bit settings such that they are considered as data zone sectors (except for the lead-in and the lead-out of the first session).

Preferably, the recorded data is divided symmetrically over both layers, even in a single session (see figure 2 and the co-pending European Patent Application EP03102608.1 (PHNL031034)) and even when data has to be added later on.

The advantages of this invention are flexibility, ease of use (for example, the first session will play in many DVD video players), reduced finalization time, efficient use of storage capacity, and compatibility with the various DVD standards (Such as DVD-ROM and dingle layer DVD+R).

These and further aspects and advantages of the invention will be discussed hereinafter with reference to the accompanying figures, where

Figure 1 is a schematic drawing of a OTP type DVD-ROM compatible disc with a single session,

Figure 2 is a schematic drawing of a partially recorded and finalized OTP type dual layer DVD disc,

Figure 3 is a schematic drawing of a finalized OTP type dual layer DVD disc comprising 4 sessions, where the dummy data region in session 4 is indicated, and

Figure 4 is a schematic drawing of a super session.

As an example an embodiment of the invention with a multi-session multi layer DVD+R disc of the OTP type will be described. The session format is similar to DVD+R; layer jumps in a session are allowed. The data zone is defined as follows (with reference to figure 1): The first PSN in the data zone on the L0 layer is $(30000)_{hex}$. The middle zone position is fixed, that is, it is placed after the last PSN address of the data zone on the L0 layer, that is at $(22D7DF)_{hex}$. The first PSN on the data zone at the L1 layer is $(DD2820)_{hex}$. The last PSN address on the data zone of the L1 layer is $(FCFFFF)_{hex}$. The physical sectors in the intro, closure, and jump zones shall have bits 27 and 26 of the data frame set to zero, identifying these zones as if they were data zones.

An updated temporary file system should preferably be placed in each session.

The multi-session format for multi layer discs allows new sessions to be added, even after the first super session is present on the disc. The files in the sessions can be distributed symmetrically over both layers. Hence, there are no, or only small, empty spaces, and the disc can be played on most DVD ROM players after session closure (that is, fill all spaces with dummy data). All sessions can be read in multi-session DVD players and PC drives. Sessions may include zero or more layer jumps.

A finalized multi layer DVD multi session disc according to the invention is shown in figure 3. Figure 3 shows a DVD disc comprising four sessions. The sessions are written in the order of the session numbers. Sessions 1, 2 and 4 contain a layer jump; session 3 does not (session 3 could, for example, be too small for a layer jump). When an user decides to finalize the disc at this time (4 sessions), a limited finalization time is needed (dummy data is written to a part of session 4 only) and disc capacity is efficiently used.

Each session has its own intro, (temporary) file system info, data zone, jump zone and closure zone (see figure 4). The size of the jump zone should preferably be sufficiently large. During a layer jump at the end of the data zone there should preferably be data written on the other layer. It is proposed to fix the jump zone size to eliminate errors after a layer jump. A preferred jump zone size is approximately 1024 ECC blocks.

Each session contains the file system info of the session itself and of all of the previous sessions. The first session uses the lead-in and lead-out zones for intro and closure. When a session is closed, the file system should be updated. Spaces are filled with dummy data.

To enable data retrieval in DVD-ROM drives, the disc should have a lead-in zone, no blank areas in the data zone, a middle zone, and a lead-out zone. When the decision is made to finalize the disc, all blank areas are filled, the lead-in and lead-out zones are written, and the file system is updated.

To remain compatible with the single layer DVD+R standard, the following measures are proposed. In the inner-drive zone (see figure 2) there are Optimum Power Calibration (OPC) areas, OPC count zones, administration zones, and a table of contents zone (TOC zone). The TOC zone contains information of the sessions on the disc and a recorded area indicator. A description of the format of a TOC block can be found on page 48 of the DVD+R standard, version 1.11. In the TOC ECC block there are so-called TOC items of 16 bytes. The TOC items are listed in Table 1.

According to the current invention, the following is modified for the super session. The last PSN on the L0 layer is put in bytes B13-B15. In this way the physical

address span of a super session can be defined using the existing TOC block format. In principle, multi layer jumps can be present in a single session. This is however not relevant for the physical definition of a super session.

In every session (in the intro part) there is an inner session identification zone and a session control data zone. The session disc control block (SDCB) contains important information on the present and previous sessions. The format of the SDCB can be found on page 64 of the DVD+R standard, version 1.11. The parts of this SDCB most relevant for the present invention are the session items. There are two types, the fragment item and the previous session item. They are described in Table 2 and Table 3.

Referring to the fragment item shown in Table 2: the bytes 11 to 13 in fragment item in the SDCB are free, and, in an embodiment of the invention, are used to store the location of the maximum PSN of the session on L0. Bytes 14 and 15 remain reserved (00).

Referring to the previous session item shown in Table 3: again bytes 11 to 15 are free, and, in an embodiment of the invention, bytes 11 to13 are used to specify the maximum PSN of session n on the L0 layer. Bytes 14 and 15 remain reserved and are set to (00).

The two jump zones should be of sufficient size and should preferably contain at least one 1 ECC block. At least one dummy ECC block should be written on the L0 layer and on the L1 layer for run-out, respectively, run-in, preferably immediately before and after a layer jump. After a session closure all open areas should be filled with dummy data, and the most recent file system should be written. Furthermore, the jump zones on the L0 layer and on the L1 layer should be filled, preferably with (00).

The size of the jump zone should be sufficiently large (for example 960 ECC blocks) to guarantee that data is present on the other layer during a layer jump at the maximum data PSN of the L0 layer.

A schematic drawing of an OTP session with the different blocks is shown in figure 4. When a new session is started, an intro and closure zone (for example having a size of 64 ECC blocks) should be written adjacent to the jump zone of the previous session. The following procedures are similar to those for the first session.

Although the invention is described with reference to a dual layer DVD+R disc of the OTP type, it is noted that the invention is also applicable to other multi layer optical disc formats, including the PTP format.

Item Byte Position	Description	Number of Bytes
B0 to B2	TOC Item Descriptor ("TCI")	3
B3	Session status	1
B4	Session number	1
B5 to B7	Session start address	3
B8 to B10	Session end address	3
B11 to B12	Last fragment number in session	2
B13 to B15	Reserved (00) Becomes: last session PSN on L0	3

Table 1: TOC Items DVD+R version 1.11

Item Byte Position	Description	Number of Bytes
B0 to B2	Fragment Item Descriptor ("FRG")	3
B3 to B4	Fragment number	2
B5 to B7	Fragment start address	3
B8 to B10	Fragment end address	3
B11 to B15	Reserved (00) *Becomes: 11...13: last session PSN on L0*	2

Table 2: Fragment item in DVD+R version 1.11

Item Byte Position	Description	Number of Bytes
B0 to B2	Previous Session item Descriptor ("TCI")	3
B3	Reserved and set to (00)	1
B4	Previous Session Number	1
B5 to B7	Previous Session Start address	3
B8 to B10	Previous Session End address	3
B11 to B15	Reserved (00) *Becomes: 11...13: last session PSN on L0*	3

Table 3: Previous session Item in DVD+R version 1.11

CLAIMS:

1. Method for recording information on a record carrier, said record carrier comprising at least two information layers for storing the information, wherein the method is adapted for recording the information in multiple sessions.

2. Method according to claim 1, wherein the information of at least one session is distributed over the at least two information layers.

3. Method according to claim 2, wherein the information is evenly distributed over the at least two information layers.

4. Device for recording information on a record carrier, said record carrier comprising at least two information layers for storing the information, wherein the device is operative for recording the information in multiple sessions.

5. Device according to claim 4, wherein the device is operative in at least one session for performing a layer jump during the recording of information.

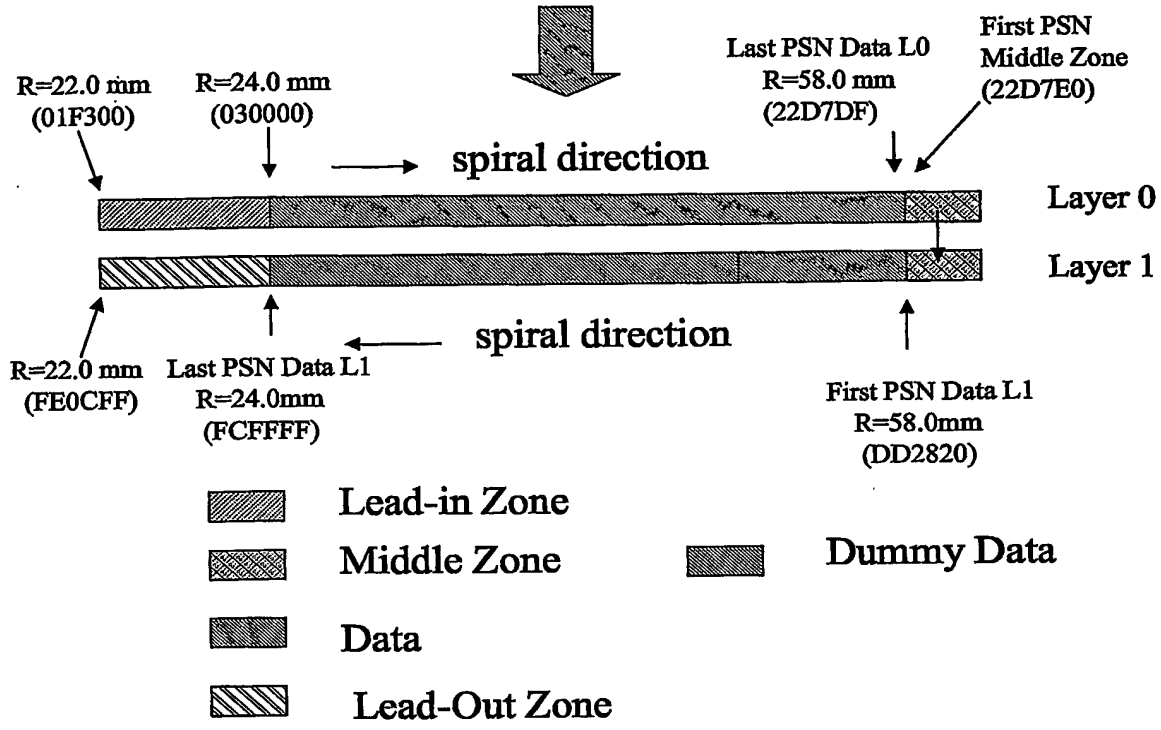

FIG. 1

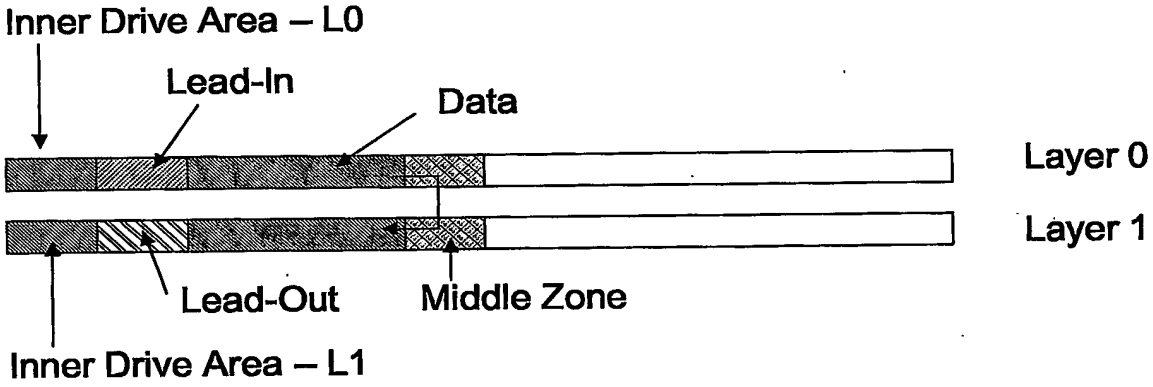

FIG. 2

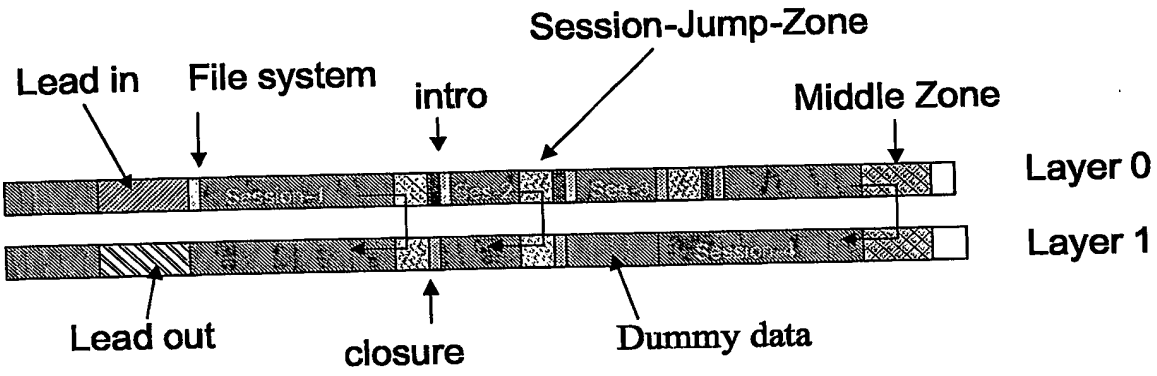

FIG. 3

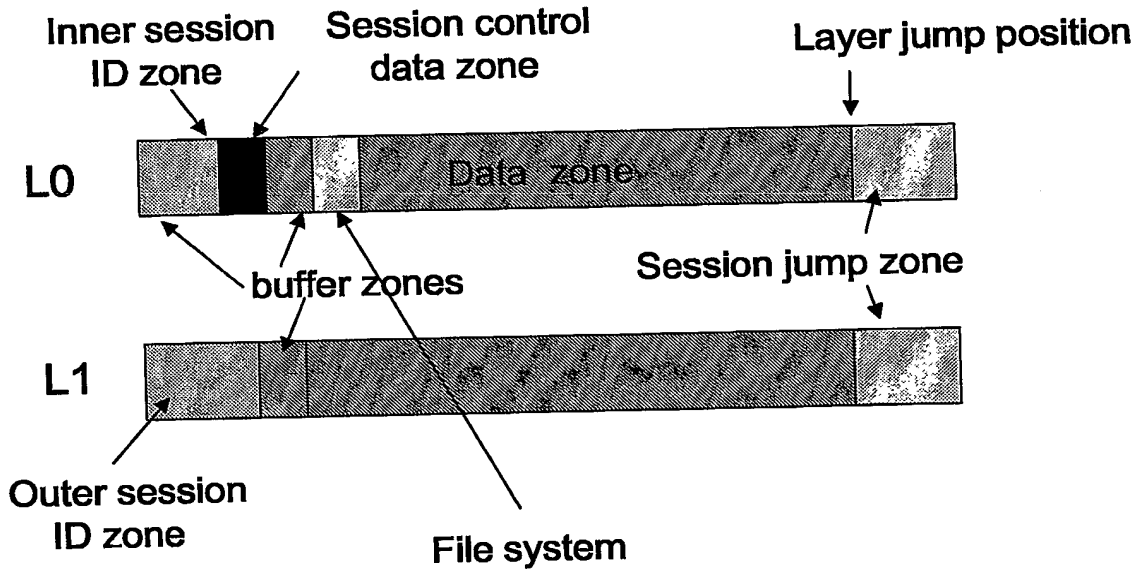

FIG. 4